VOLUME XVII NUMBER 2 WHOLE NUMBER 128

# THE JOURNAL
## OF
# THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

EDITOR
C. A. CHANT
*University of Toronto, Toronto*

ASSOCIATE EDITORS
OTTO KLOTZ
*Director of the Dominion Observatory, Ottawa*
SIR FREDERIC STUPART
*Director of the Meteorological Service of Canada, Toronto*

J. S. PLASKETT
*Director of the Dominion Astrophysical Observatory, Victoria, B.C.*

PUBLISHED MONTHLY
*(Ten numbers per year)*

March, 1923

PRINTED FOR THE SOCIETY
TORONTO: 198 COLLEGE ST.

FOREIGN AGENTS: WHELDON & WESLEY LTD.
38 GT. QUEEN ST., KINGSWAY, LONDON

# THE JOURNAL

OF THE

## ROYAL ASTRONOMICAL SOCIETY

## OF CANADA

VOL. XVII, No. 2 MARCH, 1923 WHOLE NUMBER 128

**Articles** PAGE

The Work of the Royal Astronomical Society of Canada and a Review of Astronomical Progress in 1922 *W. E. W. Jackson* 49
Annual General Meeting (Minutes and Reports) - - - 59
Astronomical Science and Modern Philosophy *Joseph F. Heffron* 70
Wireless Time Signals Observed at Ottawa *R. Meldrum Stewart* 79
The Life and Work of Tycho Brahé - - - *R. A. Gray* 82

**Review of Publications** - - - - - - - - - - - 89
**Notes and Queries** - - - - - - - - - - - - 91
**Meetings of the Society** - - - - - - - - - - - 94

**Upon request, made previous to publication of article, contributors will be supplied free either with fifty copies of the issue containing the article, or with the sheets containing the article stitched in a printed cover. If separate reprints are desired the cost will be as follows:**

| | 4 pp. | 8 pp. | 12 pp. | 16 pp. | 20 pp. | 24 pp. |
|---|---|---|---|---|---|---|
| 50 copies | $3 50 | $6 50 | $ 9 50 | $10 00 | $13 00 | $16 00 |
| 100 copies | 4 00 | 7 00 | 10 00 | 11 00 | 14 00 | 18 00 |
| 200 copies | 4 50 | 8 00 | 11 00 | 12 00 | 15 50 | 20 00 |

Covers, extra, 50 copies, $1.50; 100 copies, $2.00; 200 copies, $2.50.

Business correspondence, remittances, etc., should be addressed to H. W. Barker, Treasurer of the Society, 198 College Street, Toronto.

Communications regarding Library matters should be addressed to the Librarian.

$2.00 per annum. Single numbers, 25 cents.

Subscription to the JOURNAL is included in membership fee.

# THE JOURNAL
## OF THE
## ROYAL ASTRONOMICAL SOCIETY
## OF CANADA

VOL. XVII MARCH, 1923 No. 2


## THE WORK OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA AND A REVIEW OF ASTRONOMICAL PROGRESS IN 1922.


By W. E. W. JACKSON


*President's Address at Annual At-Home*

BEFORE proceeding with the subject which I have chosen for my address I must, first of all, express to you my appreciation and thanks for the high honour you have conferred upon me in electing me your President for another year.

The Royal Astronomical Society of Canada had its beginning in a small group of eight astronomical enthusiasts back in 1868. They had practically no equipment, either instrumental or otherwise, but what they lacked in that respect they made up in their desire to improve their minds in knowledge of the laws and forces which govern and control the universe. They endeavoured to meet monthly, usually in the home of one of the members, where they would read extracts from publications of anything new bearing on the subject of astronomy, and then discuss the merits of any theory advanced. Their object, as stated in the minutes of their first meeting, being "to aid one another in the pursuit of astronomical knowledge."

The development of our Society from this small beginning up almost to the present time was very ably presented to you in the

presidential address of Dr. A. D. Watson in 1917, and anyone desiring to know something of the history of our Society would do well to consult the JOURNAL of February, 1917, in which he will find that address complete.

Since 1917, and particularly during the past year, the growth of our Society has been very gratifying as it evidences a greater interest on the part of the public in the higher things of life. The effect of the study of Astronomy on the mind of man is extremely difficult to gauge, but we know that in its appeal to the imagination it must necessarily broaden man's outlook and compel in the individual more than respect for the great Architect of the universe, and indeed make life more worth living.

The object of our Society is still to aid one another in the pursuit of astronomical knowledge, but more than that, it is to arouse interest in others by the dissemination of astronomical knowledge so that all may benefit and our civilization improve and be better for our having lived.

A great many people have the idea that astronomical investigation and studies has little, if any, practical application in everyday life, but this is a great mistake. The crucial point of all contracts is time, and, as you know, the fundamental timekeeper is the diurnal rotation of the earth. Our great national railways would be unable to carry on without both an accurate knowledge and the observance of time. Astronomy supplies also the means of determining the latitudes and longitudes of places on the earth's surface, and by such determinations alone is navigation made secure.

In ancient times it was even supposed to have a very much greater utility. It was supposed that human affairs of every kind, national, as well as of the individual, were controlled by the motions of the stars and planets, and intense study of the heavens was made with the idea of predicting the future. This pseudo-science of astrology, absurd and baseless, as it has been proved to be, has still a remarkable hold on the popular mind. Its redeeming feature is that it has made astronomy, in addition to being the oldest science, also the most perfect.

How are we endeavouring to disseminate astronomical knowledge? By public meetings, by our JOURNAL and library, and by

encouraging observations of the heavens. At the public meetings subjects both old and new in astronomy are presented and opportunity for discussion is given. At our meetings also the opportunity is given for members or others to make reports of personal observations, and this is one feature of our meetings which is very helpful to the amateur observer, but, unfortunately, the greater number of our members fail to avail themselves of this method of improving their astronomical knowledge. With the aid of our star maps anyone can soon become familiar with the heavens and be able to fix his position with as great ease as he finds his own doorstep. And there are many things which the amateur may observe and, by reporting, make valuable contributions to the store of astronomical knowledge. I would like to have very many more of our members, for instance, make observations of meteors and shooting stars. These small objects are a part of our solar system and yet very little is known of them, as only rarely do some fragments reach the earth's surface.

In observing them as accurate an estimate as possible should be made of the altitude and azimuth at moments which can be identified, and also of the time taken to traverse definite portions of the path. The altitude and azimuth give the necessary data for determining the height and position, while the time observation gives the means for determining velocity. By day it is necessary to use natural objects or buildings to define the place of the meteor, the observer at the same time marking the place where he stands, and later with an instrument ascertaining the azimuth and altitude. At night the stars furnish the best reference points. The time of flight may be arrived at by the observer repeating some familiar verse, and then by rehearsing before a clock, obtain the number of seconds fairly accurately.

If our members would co-operate in an endeavour to add such useful information to our knowledge our meetings would become, as Dr. Coué might say, "in every way better and better."

These public meetings are being held at widely separated points in our Dominion, for our Society has broadened out and now has active centres also at Montreal, Ottawa, London, Winnipeg and Victoria. It is a cause for regret to know that Rev. W. T. B. Crombie, who was instrumental in obtaining the formation of

the Montreal Centre, has been obliged, through ill-health, to give up active work, and we can only hope that he will soon be restored to his accustomed health, and again be able to give of his time and energy to the work he loves so well.

It is very gratifying to the officers and members of our Society to know of the very vigorous condition these centres of our Society are in at present, as reported to the Annual Meeting last week, and particularly the London centre, the latest addition to our system.

I may be permitted to state here that each centre has complete control over its own affairs. The fee for members, and it is only a nominal one of $2.00 per member per year, and this also includes subscription to our JOURNAL and HANDBOOK, is forwarded to the General Treasurer of the Society, and the Council apportions grants to the various centres proportional to the amount contributed to the general funds. The Society receives a grant of $2,000 from the Dominion Government and $600 from the Ontario Government. The Toronto Centre also obtains a grant of $100 from the city of Toronto. The Government grants are used chiefly in meeting the expenses of publication of our JOURNAL, which is the second means we use of furthering the aims of our Society. This JOURNAL, published under the able editorship of Prof. Chant, gives to the members the very latest news in the astronomical world in both technical and popular presentations, and is doing a very great work in spreading astronomical knowledge, and is recognized as one of the leading astronomical publications.

The third way in which we try to popularize astronomy is by means of open-air meetings with the aid of the telescope. At Toronto, in co-operation with the University, a telescope was placed on the lawn each Saturday night during the past summer in charge of a capable instructor, and a view of the different heavenly bodies visible during the summer was made possible for anyone interested. At Ottawa and Victoria the large telescopes of the respective observatories are made available to the public, through the courtesy of the Directors, one evening each week, and many visitors attest to the value of this privilege.

It is the hope of our Society that in the not distant future it may be possible to have our headquarters established in an astro-

nomical observatory in Toronto, where similar privileges of viewing the heavens through a large telescope may be secured for the public.

Our Society is working in co-operation with the University for the attainment of this object. Considerable progress has, as you know, already been made. A valuable site has been granted by the City of Toronto, and the University has expressed a willingness to maintain such an observatory, and our Society is willing to place its valuable library of many thousand volumes in the observatory and maintain it open to the public. The Society's headquarters, as I suggested before, would be in the observatory, and provision will be made for holding our regular meetings there. All that is needed to complete the project is the building and equipment, and it is needless to say it will be a lasting and beautiful memorial to anyone associated with its foundation.

Coming now to the second part of my address, I wish for a few minutes to bring to your attention some of the outstanding astronomical events of 1922 and some important announcements affecting our concepts of the universe that have been made during the past year. Perhaps the most outstanding event of the year was the solar eclipse of September 21, for which such great preparations had been made. Astronomers from Europe, India and America early in the summer set out for different points along the path of totality, which commenced on the east coast of Africa at sunrise, travelled across the Indian Ocean, entered Australia at Wallal about midday, and crossing the continent of Australia, ended at sunset out on the Pacific Ocean to the north of New Zealand.

Following Prof. Einstein's announcement of his theory of relativity, a new incentive was given to the research astronomer to procure evidence which will either support or refute this theory, and so we had this migration of astronomers to far-off lands in order to secure photographic plates showing the distribution of starry worlds at the time the moon shut off the light from our energizing orb. It is particularly gratifying to our Society to know that it was so ably represented on this quest for knowledge by Dr. Chant, a past president of the Society, and by Dr. Young, of the Dominion Astrophysical Observatory at Victoria, who is at

present secretary of the Victoria Centre. Dr. Chant has already told us of his trip and described in detail the preparations made for observing the eclipse. He also told us how they were favoured with exceptionally fine weather for the great event, and that he was successful in obtaining plates during totality for testing the Einstein effect. The public at large, as well as all astronomers, are keenly interested in the results, which will be announced in due time after the rigorous analysis to which these plates are at present being subjected by Dr. Young is completed.

The general nature, composition and structure of the corona is another subject of investigation which it is only possible to carry on during a total eclipse, and this also was carefully observed by the different parties and photographs were obtained which are now being studied.

Work in the solar physics field has made considerable progress as evidenced by recent reports of different observatories. It has been announced by Dr. Abbot, of the Astrophysical Observatory of the Smithsonian Institution, that their results enable them to reach the conclusion "that the variations of the sun decidedly affect the earth's weather. There is indeed great hope that a study of them will yield results of value for forecasting purposes." In fact he states "that the Government weather services of Argentine and Brazil have become so fully impressed with the value of this information that they employ the telegraphic daily reports from the Smithsonian Institution at Montezuma, Chile, regularly in their official forecasts."

The extremely complicated nature of atmospheric movements in middle latitudes makes it seem very improbable to me that daily solar radiation data will afford much assistance to the forecaster in issuing his daily weather forecasts for those regions. The variations in the solar radiation may be observed more or less directly in equatorial regions, where terrestrial absorption and radiation are the main factors at work, but this is hardly the case elsewhere. Greater radiation may produce an increase in trade winds which in turn affect the ocean currents and an increase in these currents indirectly will affect the formation of the cyclonic disturbances in the atmosphere over the North Pacific and North Atlantic Oceans, which will again act to break up the anticyclones

which dominate the weather of the great land areas of North America and Asia during the winter months. Thus you can see how a long chain of circumstances are involved before the weather in middle latitudes would reflect variations in solar radiation.

A study of these variations in their relation to seasonal weather is likely to be much more productive of results, and I am very optimistic that before long it will be possible to forecast the general climatic conditions for the different seasons in advance, and the agriculturist, who is the mainstay of the country, will then have no more fears for the very dry or very wet seasons, as he will be able beforehand to determine the nature of the operations he must carry on in order to enable him to reap a bountiful harvest. Insofar as daily weather forecasting is affected in the Canadian weather service, much greater aid is expected from the information which, we hope, will soon be available from the great MacKenzie River basin. We are assured that a series of wireless stations are to be established in that area in the near future, and it will then be possible to obtain daily reliable information from the centre of the greatest natural cold storage system on the American continent.

Passing now from the sun to the planets, the question of the possibility of intelligent life on other heavenly bodies than the earth was again raised owing to the near approach of Mars (about 42,000,000 miles) in the early summer. The general consensus of opinion among astronomers now is that intelligent life on Mars is merely fanciful. As to life on other planets, the recent announcement of Dr. St. John, of the Mount Wilson Observatory, California, that spectroscopic studies of Venus indicate the absence of oxygen on that planet is momentous. It throws doubt on the existence of water vapour there and the fact that, as Dr. Shapley of Harvard has recently told us, the question of habitability depends on the presence of water vapour, would appear to make the case complete against the assumption that there may be life on Venus. No information is given in the announcement explanatory of the nature and composition of the clouds which continually surround the planet Venus and until this is available it would be unwise to speculate further. It is also announced that in view of the success attending Dr. St. John's spectroscopic investigations of Venus that

in the near future they will be extended to investigate the planets Mars and Jupiter.

A new theory has also been advanced in regard to the comets of the solar system by Prof. Stroemgren, royal astronomer of Denmark. After some twenty-two years of research and rigorous mathematical investigations he supports the theory that comets are not visitors from outer space but all were originally members of the solar system. Newton, Halley, and their successors, showed that comets were governed by the universal law of gravitation. Their movements are controlled by the sun, the dominating power in this region of space, but are affected or disturbed by the influence of the different planets. Astronomical calculations show that the orbits are either elliptical, parabolic or hyperbolic. The first is a closed curve and the other two are not closed, and comets travelling in such orbits return periodically to the neighbourhood of the sun or pass forever beyond the limits of the solar system. This new theory of Prof. Stroemgren maintains that all comets originally travelled in closed curves and were a part of the original nebula out of which the sun and his family are thought to have been formed. The perturbation produced by their approach to the neighbourhood of a planet is quite sufficient to change the orbits of some comets from the closed to the open form and when this occurs, these comets pass out into the emptiness of interstellar space never to return.

In the region beyond the solar system the spectroscope and photograph are working hand in hand in extending our knowledge of the limits of the universe, and our own Canadian observatory at Victoria, under the guidance of Dr. Plaskett, is gaining world-wide renown in this special work of applying the measuring rod to the size of our universe. The announcement made last June of the discovery of the great mass of the spectroscopic binary No. 47129 of the Henry Draper Catalogue by Dr. Plaskett resounded throughout the press of the country, and yet this was only a by-product to the fundamental work of measuring radial velocities and parallax. It is, of course, very gratifying to us as Canadians to know of the work being accomplished in our own observatories. An account of Dr. Plaskett's discovery is published in the November, 1922, issue of our JOURNAL, and I will refer

anyone interested to the detailed report given there. A very brief summary, however, of this giant system may be of interest. It consists of two enormous suns 10,000 light-years away, each at a temperature of about 30,000° F., revolving about one another in a little over 14 days and separated by about 55,000,000 miles. The more massive has a mass at least 75 times the sun, 19.5 times its diameter and 15,000 times as bright and moves with a velocity of 130 miles per second. The fainter has a mass at least 63 times the sun, is 18 times its diameter and 12,000 times as bright and moves with a velocity of 155 miles per second. The system is receding from the sun with a speed of 24 km. per second and the spectra also show the presence of calcium vapour receding at the rate of 16 km. per second. This latter phenomenon is generally found also in most of the novae and supports the theory of the presence of stationary calcium clouds in space.

It is interesting to note that during the year it was announced by Dr. Shapley that in the course of a detailed study of the globular system Messier 5, an extremely delicate test was made of the relative velocity of light of different colours. He found that "radiations which differ in wave-length by about twenty per cent., and in amplitude as well, can travel through space for 40,000 years without losing more than one or two minutes with respect to each other if indeed there is any difference whatever."

Two thousand new nebulae have been added to the lists by the work of Mr. Menzel at Arequipa with the 24-inch Bruce telescope. Most of these are reported to be south of declination $-45°$. Of the eight hundred brightest ones 35 per cent. are reported to be spirals and most of the remainder of the globular nebula type.

A nova of the first magnitude in Lyra was reported to have been discovered by Zwierel in Roumania on Dec. 1, 1922, but photographs made at Harvard Observatory on the night of Nov. 28 show no star as bright as 11.5 in the position given, and photographs made Dec. 4 also fail to show a nova in this vicinity. Novae of this magnitude are of extremely rare occurrence.

In conclusion, let me read to you that excellent little poem by Joseph B. White on "Mysterious Night." It may prove to be an inspiration to many of us to continue on in the pursuit of astro-

nomical knowledge which will broaden our views and lead to a fuller development and appreciation of the higher and better things of life.

> Mysterious night! When our first parent knew
> Thee from report divine, and heard thy name,
> Did he not tremble for this lovely frame,
> This glorious canopy of light and blue?
> Yet 'neath a curtain of translucent dew,
> Bathed in the rays of the great setting flame,
> Hesperus with the host of heaven came,
> And lo! Creation widened in man's view.
> Who could have thought such darkness lay concealed
> Within thy beams, O Sun! or who could find,
> Whilst flower and leaf and insect stood revealed,
> That to such countless orbs thou mad'st us blind!
> Why do we, then, shun death with anxious strife?
> If light can thus deceive, wherefore not Life?

Toronto, Ont.

## ANNUAL GENERAL MEETING

THE Annual General Meeting of the Society was held in the Physics Building of the University of Toronto, at 8 p.m., January 16, 1923, the President, Mr. W. E. W. Jackson, in the chair.

On motion, the minutes of the last annual meeting, as printed in the JOURNAL, were approved.

Miss E. M. Budd and Mr. F. Hooker were appointed scrutineers to count the ballots cast for the election of the officers for 1923.

The General Secretary presented and read his report for 1922, which included the reports of the various centres, five in all, and on his motion, seconded by Prof. C. A. Chant, it was received and adopted.

The General Treasurer's report of the receipts and expenditures for 1922 was presented and read, and on motion was received and adopted.

The Librarian presented and read his report for 1922, and on his motion, seconded by A. F. Hunter, it was received and adopted.

The scrutineers reported that the following officers for 1923 had been elected:—*Honorary President*, Hon. R. H. Grant, Minister of Education for Ontario, Toronto; *President*, W. E. W. Jackson, M.A., Toronto; *First Vice-President*, Wm. Bruce, J.P., Hamilton; *Second Vice-President*, R. M. Stewart, M.A., Ottawa; *General Secretary*, A. F. Hunter, M.A., Toronto; *General Treasurer*, H. W. Barker, Toronto; *Recorder*, J. H. Horning, M.A.; *Librarian*, Prof. C. A. Chant; *Curator*, Robert S. Duncan; *Council*, Mgr. C. P. Choquette, M.A., Lic. Scs., Montreal; L. Gilchrist, M.A., Ph.D., Toronto; R. A. Gray, B.A., Toronto; A. R. Hassard, B.C.L., Toronto; [1]H. R. Kingston, M.A., Ph.D., London, Ont.; Otto Klotz, LL.D., D.Sc., F.R.A.S., Ottawa; Sir Joseph Pope, K.C.M.G., Ottawa; John Satterly, M.A., D.Sc., Toronto; Stuart Strathy, Toronto; Dr. W. M. Wunder, Toronto.

---

[1]An error having occurred in the preparation of the ballot paper, and Prof. Kingston's name being already in the list of members of Council, Prof. John Matheson, M.A., of Kingston, was elected at the subsequent meeting of Council.

The President declared that the above officers were elected for the year 1923.

On motion by Prof. Chant, seconded by Mr. F. Hooker, it was resolved that the thanks of the Society be conveyed to the auditors, Dr. J. B. Fraser and Mr. A. R. Hassard, for their services, and that they be asked to continue in office for 1923.

Arrangements for the more complete definition of the Society's finances in the reports for publication were referred to the Council for action.

The meeting was then adjourned.

## REPORT OF THE GENERAL SECRETARY FOR 1922.

There has been a substantial increase of members during the year 1922, the total number now being 556 as against 507 at the close of the preceding year. The following table shows the figures according to Centres as shown by the Society's mailing list of January 1st, 1923:

| Centre | 1921 | 1922 |
|---|---|---|
| Toronto | 205 | (city) 111 |
| | | (outside) 120 |
| Guelph | 17 | .. |
| Ottawa | 88 | 81 |
| Hamilton | 9 | 8 |
| Victoria, B.C. | 60 | 54 |
| Winnipeg | 54 | 61 |
| Montreal | 74 | 71 |
| London, Ont. | .. | 50 |
| | 507 | 556 |

In addition to these ordinary members there are 16 honorary fellows, 2 corresponding members and 19 subscribers to the JOURNAL. It is with much satisfaction that the organization of a Centre in London, Ont., during the year is here placed on record.

There have been 18 meetings held at Toronto during the Society's year just closed, at which 15 valuable papers and addresses were delivered as follows:—

1922.

January 24.—Mr. J. R. Collins, "Ancient and Modern Theories of the Universe".
February 7.—Mr. William Park, "Science with Motion Pictures", (the astronomical parts being illustrated by motion pictures on "Worlds in the Making", "The Mystery of Space", and "The Earth and Moon").

A special course of lectures then followed, descriptive of the work carried on in the Meterological and Magnetic Observatories, viz.:

February 23.—Sir Frederic Stupart, "The Weather and How to Forecast it".
March 2.—John Patterson, M.A., F.R.S.C., "The Upper Air; Earthquakes".
March 14.—W. E. W. Jackson, M.A., "The Magnetism of the Earth".
March 21.—Prof. A. P. Coleman, F.R.S., "Ancient Ice-Ages".
April 4.—Mr. J. F. Heffron, "Astronomical Science and Modern Philosophy".
April 18.—Prof. L. B. Stewart, "Geodetic Reconnaissance".
May 2.—A. D. Watson, M.D., "The Norse Discovery of America".
May 16.—Rev. D. B. Marsh, "Astronomy in Bermuda".
October 24.—R. A. Gray, B.A., "The Life and Works of Tycho Brahe".
November 7.—Mr. J. R. Collins, "Concepts of Space".
November 23.—Dr. Harlow Shapley, "The Evolution of the Earth".
December 5.—Prof. C. V. Pilcher, M.A., D.D., "The Stars in Literature".
December 19.—Prof. C. A. Chant, "An Astronomical Trip to Australia".

It may be remarked that in the above list, only persons living within the city took part, with the exception of Rev. D. B. Marsh, of Bermuda, and Dr. Harlow Shapley, of the Harvard College Observatory.

During the year a total eclipse of the sun occurred in Australia, and it afforded satisfaction to all classes of our members that Prof. C. A. Chant was enabled to take part on that occasion in the investigation of the Einstein effect. Favourable weather attended the observations by his party, and the expedition obtained results of real value, in co-operation with the expedition in charge of Prof. W. W. Campbell of the Lick Observatory.

Respectfully submitted,
A. F. HUNTER,
*General Secretary.*

## TREASURER'S STATEMENT FOR YEAR ENDED DECEMBER 31ST, 1922

### RECEIPTS

| | |
|---|---|
| Cash in Bank December 31st, 1921 | $ 598.58 |
| Grant from Dominion Government | 2,000.00 |
| " " Ontario " | 600.00 |
| " " City of Toronto | 100.00 |

RECEIPTS—*Continued*

| | | |
|---|---|---|
| University of Toronto (50 copies "Journal") | $100.00 | |
| Fees from Members | 1,076.85 | |
| Interest and Discount | 131.63 | |
| Sundry Receipts (sale of magazines, etc.) | 163.28 | |
| | | $4,770.34 |

DISBURSEMENTS

| | | |
|---|---|---|
| Publication "Journal" and "Handbook" | $1,693.24 | |
| Public Meetings at Toronto[1] | 232.20 | |
| Library Account (books, etc.) | 248.79 | |
| Stationery, stamps and exchange | 280.82 | |
| Salaries (Assistant Librarian and Caretaker) | 430.00 | |
| Rent of Rooms | 121.00 | |
| Grant to Ottawa Centre | 100.00 | |
| " " Victoria " | 100.00 | |
| " " Montreal " | 100.00 | |
| " " Winnipeg " | 100.00 | |
| " " London " | 25.00 | |
| Eclipse Expedition | 500.00 | |
| Miscellaneous Expenditure | 44.58 | |
| | $3.974.63 | |
| Balance in Bank | 795.71 | |
| | | $4,770.34 |

Respectfully submitted,
(Signed) H. W. BARKER,
*General Treasurer.*

Audited and found correct,
(Signed) A. R. HASSARD,
J. B. FRASER, M.D.,
*Auditors.*

## LIBRARIAN'S REPORT

The Librarian, Prof. C. A. Chant, reported as follows:—

During the year the periodicals received were from Canada and the Empire, 270; from the United States, 215; from other countries, 177. Total 662. In addition various volumes chiefly recent publications were added. An attempt is being made to make complete some of the extended series of periodicals which the Society possesses.

[1]Printing and Advertisement, $76.20; Rent of Rooms, $91.00; "At-Home" Refreshments, $40.00; Visiting Lecturer's Travelling Expenses, $25.00: Total, $232.20.

Requests for the JOURNAL continue to come from various parts of the world, and at present the number of exchanges is 133.

A greater use of the Library was made than in previous years, and it is to be hoped that more suitable accommodation will be available in the near future, so that many more may take advantage of it.

## MONTREAL CENTRE

The following are the officers of the Montreal Centre for 1923:—*Honorary President*, Mgr. C. P. Choquette, Lic. Sc.; *President*, Mr. Justice E. E. Howard; *First Vice-President*, A. S. Eve, D.Sc., C.B.E., F.R.S.; *Second Vice-President*, H. E. S. Asbury; *Secretary-Treasurer*, A. W. Strong; *Recorder*, L. Sessenwein; *Council*, Prof. L. V. King, F. R. Robert, Prof. Gillson, Miss M. Ellicott, John Corway, George Sample, Prof. James Weir.

### FINANCIAL STATEMENT

December 14, 1921—December 7, 1922.

RECEIPTS

| | | |
|---|---|---|
| Balance on hand December 13, 1921 | $ 48.25 | |
| Fees from 56 members for 1922 | 112.00 | |
| " " 3 members October-December, 1922 | 1.50 | |
| " " 3 members for 1923 | 6.00 | |
| Exchange and Interest | 2.30 | |
| Grant from General Society | 100.00 | |
| Total Receipts | | $270.05 |

EXPENDITURES

| | | |
|---|---|---|
| Fees sent General Treasurer | $131.50 | |
| Postage and Commissions | 11.63 | |
| Printing of Notice Cards (500) | 3.50 | |
| Expenses of Dr. McDiarmid (Lecturer) | 11.00 | |
| Express on Slides | .75 | |
| Expenses of Local Secretary (as ordered by Council) | 18.30 | |
| Charges of Lantern Operator | 7.50 | |
| Charges of Janitor | 9.00 | |
| Total Expenditures | | $193.18 |
| December 7, 1922, Balance on hand | | $ 76.87 |

Adopted at Annual Meeting of Centre, December 14, 1922.

Respectfully submitted,

W. T. B. CROMBIE,

*Secretary-Treasurer.*

## OTTAWA CENTRE

### Secretary's Report for 1922

During the year five members resigned; five members were removed for non-payment of fees; five other members were notified that their removal would follow for non-payment of fees; nine new members were elected to membership in the Society.

At the Annual meeting of 1921 the matter was left in the hands of the new executive to arrange meetings as they should feel best. The resolution passed at this meeting was acted on. The Dominion Observatory is only open to the public on Saturday nights, and for this reason it was thought best not to hold the meetings in the Geodetic Survey Building. Dr. McInnes, Director of the Museum, very kindly gave permission to the Society to hold its meetings in the Museum. Three meetings were held in the spring and two this fall. The change of meeting place proved advisable, as the attendance has been much better than for some time.

The following lectures were given:—

Dr. F. Henroteau, Dominion Observatory, "Astronomical Photography," February 24.

Mr. W. E. W. Jackson, M.A., Meteorological Service, Toronto, "Terrestrial Magnetism," March 24.

Dr. F. J. Alcock, Geological Survey, "Volcanism," April 7.

Fall Term:

Mr. E. A. Hodgson, M.A., Dominion Observatory, "From Infancy to Maturity with Astronomy," November 15.

Dr. Harlow Shapley, Director of Harvard Observatory, "Star Clusters," November 22.

The lecture of Dr. Shapley was most gratifying to the executive, the auditorium of the Museum being filled. The lecture was the outcome of co-operation of the Ottawa Centre with Montreal and Toronto. The matter was first mentioned at a council meeting of the Montreal Centre, at which the Secretary of the Ottawa Centre was present. It was then agreed, if Dr. Shapley would come, the expenses would be shared equally; later Toronto was communicated with, and that Centre was agreeable to the scheme. Dr. Shapley was communicated with by the Secretary of the Ottawa Centre, and all arrangements made. At the three lectures there were in all about 600 attended: this is most encouraging and shows what a little working together of the different centres can

do. There is no reason why other speakers can not be secured in a similar manner.

The following are the officers for the ensuing year: *President*, Dr. R. J. McDiarmid; *Vice-President*, C. R. Coutlee, C.E.; *Secretary*, A. H. Miller, M.A. (Oxon.); *Treasurer*, W. S. McClenahan, B.A.; *Council*, Dr. T. L. Tanton; W. C. Way, M.S.C.; W. J. Stewart; and *Past Presidents*, Dr. Klotz, C. A. Bigger, D.L.S., F. A. McDiarmid, M.A., R. M. Stewart, M.A., J. J. McArthur, D.L.S., and Dr. R. E. De Lury.

R. J. McDIARMID,
*Secretary.*

December 12, 1922

FINANCIAL STATEMENT, 1922

RECEIPTS

| | | |
|---|---|---|
| Balance on hand, December 16, 1921 | $ 13.94 | |
| Grant from the General Society | 100.00 | |
| | | $113.94 |

EXPENDITURES

| | | |
|---|---|---|
| Lectures | $ 54.00 | |
| Printing | 18.67 | |
| Advertising | 17.20 | |
| Postage, exchange, etc. | 6.40 | |
| Incidentals | 4.00 | |
| | | $100.27 |
| Balance on hand, December 12, 1922 | | 13.67 |
| | | $113.94 |

Examined and found correct,
(Signed) D. ROBERTSON.

Respectfully submitted,
(Signed) D. B. NUGENT,
*Treasurer.*

December 12, 1922

## LONDON CENTRE

### SECRETARY'S REPORT

The organization of an Astronomical Society in London, Ont., was completed February 10, with a charter membership of 32. It was duly constituted a centre of the Royal Astronomical Society of Canada by the Council, February 24, 1922. During the year the membership increased to 39.

In addition to the organization meetings six regular meetings were held during the year. These meetings were well attended and an enthusiastic interest has been taken by the members in the progress of the Society.

A successful observation meeting was held on the Normal School Ground, May 7th. The following lectures were given during the year:—

March 10.—"Other Worlds in our Solar System", by H. R. Kingston, M.A., Ph.D.
April 7.—"The Moon", by E. T. White, B.A., D.Paed.
October 13.—"The Astronomy of the Bible", by Rev. R. J. Bowen, F.R.G.S.
November 10.—"Comets", by H. R. Kingston, M.A., Ph.D.

The following officers were elected for the year 1923:

*President*, H. R. Kingston, M.A., Ph.D.; *Vice-President*, Miss Grace Blackburn; *Secretary-Treasurer*, E. T. White, B.A., D.Paed.; *Executive Council*, Rev. R. J. Bowen, F.R.G.S.; H. B. Hunter, Mrs. S. R. Moore, J. C. Middleton, W. A. McKenzie.

E. T. WHITE,
*Secretary-Treasurer.*

FINANCIAL STATEMENT—FEBRUARY 10 TO DECEMBER 8, 1922.

RECEIPTS

| | | |
|---|---|---|
| Fees from 39 members for 1922 | $78.00 | |
| Fees from 8 members for 1923 | 16.00 | |
| Grant from General Treasurer | 25.00 | |
| Interest on Deposits | .16 | |
| Total Receipts | | $119.16 |

DISBURSEMENTS

| | | |
|---|---|---|
| Fees remitted to General Treasurer | $78.00 | |
| Printing and Stationery | 13.78 | |
| Postage and Exchange | .85 | |
| Cartage on Telescope | 1.00 | |
| Electric Fixtures | 2.86 | |
| Total Disbursements | | $ 96.49 |
| Balance on hand | | 22.67 |
| | | $119.16 |

Audited and found correct,
(Signed) WM. WRIGHT,
THOS. COLERIDGE,
*Auditors for 1922.*

(Signed) E. T. WHITE,
*Secretary-Treasurer.*

## WINNIPEG CENTRE

### Secretary's Report, 1922.

The Society has held nine regular meetings during the year. A social evening, entirely informal, was arranged on January 25, and a considerable number of members attended the University public lecture on astronomy, given by Professor Warren, on February 17.

The dates of the regular meetings held, the lecturers and the subjects of the lectures were as follows:—

January 11.—"The Romance of Numbers", Prof. F. S. Nowlan.
February 8.—"The Spectroscope in Astronomy", Rev. T. W. Morton.
March 8.—"The Origin of the Earth", Professor N. R. Wilson.
March 22.—"Light Waves and the Measurement of Distance", Dr. C. D. Miller.
April 12.—"Effects of Astronomy in Daily Life", Mr. H. M. Guenther.
April 26.—"Celestial Immensities", Mr. Hugh B. Allan.
October 25.—"Recent Events in Astronomy", Prof. L. A. H. Warren.
November 8.—"Shooting Stars", Rev. T. W. Morton.
November 22.—"New Zealand", Prof. V. W. Jackson.

Short talks on various subjects have been arranged, and informal discussions have been held. Tea has been served by ladies of the Society at one or two of the regular meetings.

There are at present 64 members of the Society, of whom five have been elected during the current year. As a new project and an encouragement to membership, the Society has under consideration the purchase of a small telescope for the use of the members.

The officers for 1923 are: *President*, Hugh B. Allan; *Vice-President*, Mrs. E. L. Taylor; *Secretary-Treasurer*, Dr. C. D. Miller; *Council*, Rev. Fr. T. W. Morton, B.Sc.; Prof. N. R. Wilson; Mr. J. H. Kolb; Mr. Cecil Roy; Mr. G. P. Morse, C.E.

### Treasurer's Report

Receipts

| | | |
|---|---|---|
| Balance on hand Dec. 14, 1921 | $ 79.98 | |
| Fees from 44 subscriptions | 88.00 | |
| Grant from Toronto | 100.00 | |
| Total Receipts | | $267.98 |

EXPENDITURES

| | | |
|---|---|---|
| Remittances of fees to Toronto | $94.00 | |
| Stationery, printing, office supplies | 18.30 | |
| Stenographic work | 24.60 | |
| Postage | 10.56 | |
| Exchange on cheques | .15 | |
| Tea, sugar, etc. | 3.00 | |
| Janitor services | 2.00 | |
| Total Expenditures | | $152.61 |
| Balance on hand, Dec. 13, 1922 | | $115.37 |

Audited and found correct, December 13, 1922.

(Signed) C. E. BASTIN,

H. B. ALLAN, *Auditors.*

## VICTORIA CENTRE

### SECRETARY'S REPORT, 1922

The year 1922 has been a very successful year. The annual meeting for the previous year was held February 7th so that the time has been somewhat shorter than usual. In spite of this, eight meetings of the Society have been held, as follows:—

February 28.—"The Spectroscope and its Uses", by R. K. Young.

March 28.—"Wave Motion", by P. H. Elliott.

April 25.—"The Structure of Matter", by H. H. Plaskett.

June 16.—A special meeting of the Society held in honour of Dr. C. A. Chant's visit to Victoria. The function took the form of a luncheon after which the members had the pleasure of listening to Dr. Chant speak on his eclipse expedition.

June 30.—An open-air meeting. The members of the Society availed themselves of Mr. and Mrs. Napier Denison's generous invitation to meet at the Observatory on Gonzales Hill. The members inspected the numerous scientific instruments of the Observatory, had the pleasure of seeing one of the pilot balloons sent off by which the currents in the upper air are studied and also were provided with several small telescopes to look at various astronomical phenomena.

October 26.—"The Personality and Work of Astronomers of To-day", by J. S. Plaskett.

November 21.—"Exploration of the Upper Air", by Napier Denison.

December 15.—Annual Meeting.

Executive meetings are recorded in the minute book on four dates, February 9th, April 26th, September 29th and December 11th.

Seventeen new members were elected during the year. There are now 59 members on the roll. Thirteen names have been removed from the list of last year's members.

In presenting the above report I beg to acknowledge the assistance of Mr. Symonds who has taken charge of the meetings occurring during my absence at the eclipse in Australia.

R. K. YOUNG,
*Secretary.*

TREASURER'S REPORT

| | | |
|---|---|---|
| Balance in Bank Dec. 31, 1921 | $112.66 | |
| Cash on hand | 12.00 | |
| | | $124.66 |

RECEIPTS

| | | |
|---|---|---|
| Interest June 8 | $ 0.80 | |
| Interest Oct. 31 | .70 | |
| Grant from Toronto March 20 | 100.00 | |
| 1 Subscription for 1920 | 2.00 | |
| 4 Subscriptions for 1921 | 8.00 | |
| 23 Subscriptions for 1922 | 46.00 | |
| 3 Subscriptions for 1923 | 6.00 | |
| 1 Subscription for 1924 | 2.00 | |
| | | 165.50 |
| | | $290.16 |

EXPENDITURES

| | | |
|---|---|---|
| Parent Society Feb. 9, 1922 | $122.00 | |
| Colonist Account Apl. 4, 1922 | 54.06 | |
| Colonist Account Oct. 24, 1922 | 14.44 | |
| School Board Account Oct. 24, 1922 | 17.50 | |
| Colonist Account Dec. 14, 1922 | 9.25 | |
| R. K. Young Dec. 14, 1922 | 5.60 | |
| Parent Society Dec. 14, 1922 | 62.00 | |
| | | $284.85 |
| Balance in Bank | | 2.61 |
| Cash on hand | | 2.70 |
| | | $290.16 |

Audited and found correct,
(Signed) H. H. PLASKETT

# ASTRONOMICAL SCIENCE AND MODERN PHILOSOPHY

By Joseph F. Heffron

*(Concluded from last issue)*

## Time as a Fourth Dimension

While it is difficult for us to conceive of a fourth dimension in space no such difficulty presents itself to us where the fourth dimension is time. As a matter of fact, we continually make use of this idea and would find it very difficult indeed to get along without it.

In order that we may fix the position of any event, Edwin Slosson informs us[1] we require four dimensions. Suppose a man is shot. At what point in space? In Toronto, at the corner of King and Yonge Streets. From this information we are able to fix the point in space by two co-ordinates crossing at right angles in a plane. But did the event take place above or below this plane, on the nineteenth floor of the Royal Bank Building or in its basement, or at the street level? Having this information we are able to fix the event in the third dimension, but we have still to fix the event in a fourth dimension, time. Did the event take place to-day, or last week, and at what hour? The knowledge of all four of these positions in space and in time enables us to distinguish this particular event from any other that may have occurred in other places at the same time, or at other times in the same place.

Slosson presents another simple illustration of this idea of time[2]: Suppose we were to cut a strip of motion picture film into its separate scenes, placing them upon each other in their sequential order until the pile is half as high as it is broad. We have then, let us say, a cubical event. In two dimensions our cube is spatial; while its third dimension is essentially temporal, although spatial in form. Being in order from bottom to top, if one of the films from the middle of the pack represents the present, the films below represent past events and those above the future.

---

[1] *Easy Lessons in Einstein*, p. 31.

[2] *Easy Lessons in Einstein*, pp. 31-32.

The persons on the picture we have selected from the middle of the pack are acquainted only with the scene we have selected, and they may have a fleeting memory of the past and a dim anticipation of the future. But we outside the film-pack are able to see all the scenes, past, present, or future. They are all present to us. The illustration enables us to understand how the human mind is limited in its grasp of the events of nature because of the mind's peculiar time and space conceptions, just as the people in the film-pack are limited to the narrow experience resulting from their confinement to the single fragment of film.

Were it possible for us to step outside the limitations caused by our narrow space and time conceptions we would become beings for whom past and future would form one eternal present. We would be able to see simultaneously all things that have been, are, or are to be. Theologians have conceived God to be such a being.

For such a being there would be no metronomic foundation in the sequence of occurrences, beyond what represents itself as time to our understanding. Such a being would be situated outside time in what Thomas Aquinas called the eternal present.[1] No longer limited by the necessity of a conception of the *Before* and *After*, the events in our existence would acquire the clearest and simplest meaning, similar to that given by an equation of identity. That which presents itself to us as a succession of events would merge into a single whole, in the same manner that a succession of numerical calculations become summarized in a rule of calculation, or as a series of logical operations resolves into a logical self-evident truth. A being such as this, if it actually existed, would stand above the necessity of introducing the idea of time as a quantity into its world-equations. For time appears to be a purely anthropomorphic quantity, something produced by our limited perceptions, and regulated by our own peculiar characteristic pulses. As a consequence of this view, our conception of causality, which is indissolubly connected with time, must be regarded as anthropomorphic, as something we read into, not out of, nature. This view leads us to the realization that if there is a causality outside ourselves, we can learn only a minimum about it, and even this

[1] *Sum. Theol.*, 1 q. 14, art. 13, C.

only in a world displaced or distorted by the accidental rate of our own particular pulse-beat.

If, then, space and time, and therefore the characteristics of space and time, are not real things or entities, but are merely conceptions of the human mind, it may well be that those transcendental questions, as that of immortality after death and existence before birth are not problems of fact in nature or outside of nature, but are simply meaningless. In other words, the questions of birth and death, of extinction or immortality, may be merely incidental results of the peculiarity of our conceptions of time, *the peculiarity that the time of our conceptions is irreversible*, flowing as it appears to do, at a uniform rate in the same direction from the past to the future.

As Steinmetz observes,[1] if time has no reality, and ultimately is not an existing entity, then these transcendental problems resulting from our time conception have no real existence, but are really phenomena peculiar to the human mind, and cease to exist if we go beyond the limitations of the human mind, beyond, that is, the peculiar time conceptions of the human mind.

Before leaving this point it may be made clearer by the use of one more example of the difference between our space conception and our time conception. The illustration belongs to Steinmetz.[2] Our time conception permits us to pass through time in one direction only, from the past to the future, while our space conception permits us to pass through space in any direction, from north to south, as well as from south to north; that is to say, time for us is irreversible, and flows in one direction only, while space is reversible, and may be traversed in any direction. Accordingly, when we enter an object in space, let us say, a house, we can approach it, pass through it, leave it, come back to it, and the object therefore *appears permanent to us*, and we know even when we have left the object, and it is no longer visible, that it still exists, and that we may return to it again and enter it if we so desire.

With time this is not the case. When we approach a thing in time, an event such as a human life, it extends from a point in time

[1]See *Science and Religion*, by Charles P. Steinmetz, *Harper's*, March, 1922.
[2]See same article.

(birth) over a length of time (life) to an end point in time (death) just as the house extends from a point in space (let us say from the north wall) over a length of space (its extent) to an end point in space (say the south wall) when we pass beyond the end point of an event in time (the death of a life) we find it impossible as human beings to go back to the event again; for us the event has ceased, the life is extinct, we are separated from it, we are limited by our natural constitution, just as the people on the fragment of film were separated from the events existing upon other fragments of the film-pack.

But were we to imagine that the same irreversibility that appears in our time conception might be applied to our conception of space, that we could move through space only from north to south, and not in the opposite direction, then an object in space would be the same for us as an event in time, it would not exist for us until we approached it, and it would fade from our view after we had passed through it just as is the case with our time conception of an event in nature. It may be possible that just as the house we have used as an example exists permanently for us in space, so also may our life, which appears to us to exist only during the length of time when we are between its beginning and its end point in time, have a permanent existence were we able to step outside our peculiar time conception.

At present our life does not so exist for us, apparently because our time conception does not permit us to go back to it or ahead into it. But when we assume time to be reversible, as is space, we may presume that we could go through it, backward or forward in any direction. Our life would then exist for us permanently, as a part or span of time, just as the house exists for us permanently, as a part or section of space.

This plunge into metaphysical speculation may have led you to believe that I am straying from my subject, and yet, if you admit the second of Einstein's two fundamental postulates, namely, that the speed of light is constant, regardless of the velocity of its source, you will be irresistibly led—unless you become separated from him on the way—to the conclusion that time is purely a local affair; that there is no way by which we are able to determine whether two clocks at a distance are keeping the same time, nor

yet whether two events at different places occur simultaneously.[1] It would be impossible for you to determine this even were it possible to shoot a chronometer from one place to another with the speed of light, since, according to the theory, no matter how many seconds or years the watch might be on its way it would register the same time.

Were it possible for a man to travel with the speed of light he would presumably not grow old on the way. Einstein would not agree to our analogy since he maintains that no chronometer, men, or particle of ponderable matter can travel with the speed of light. It would apparently require an infinite force to give the smallest particle of ponderable matter such a velocity. (I may here remark that I am not concerned with the nature of light, such a discussion would require considerable time.)

Were we to presume it possible that a hollow projectile, capable of containing a man, such as Jules Verne[2] and H. G. Wells,[3] make use of in their imaginary voyages to our satellite, could be sent off into space with a velocity one twenty-thousandth less than that of light, and at the end of a year the projectile were caught like a comet by the gravitational pull of some heavenly body and so swung around and sent back to the earth, the man upon emerging from his shell would be two years older, but to his surprise he would find the world two hundred years older. As Professor Langevin suggests in *Scientia*, 1911, this would be an extremely interesting but somewhat dangerous manner in which to study history.

If it were possible for us to fly through interstellar space at any speed we might choose, we would apparently have control over time as we know it. We might hasten, retard, stop or reverse the course of events simply by varying our speed. If we remained stationary, scenes on our earth would unfold at their normal rate and in their customary form. If we travelled away from the earth with the speed of light, everything on the earth would seem to stand still. If, on the other hand, we travelled faster than light, we would overtake the rays of light that had left the earth carrying images

[1]See *Relativity and Gravitation*. J. Malcolm Bird, Scientific American Co., 1921, pp. 80-86.

[2]See *From the Earth to the Moon and Around the Moon*, by Jules Verne.

[3]See *The First Men in the Moon*, by H. G. Wells.

of events farther and farther back in the past, and we would then presumably see events that had happened on earth in their reverse order, in much the same manner as when a movie operator runs his film backwards presenting all events on the film in their reverse order.

These odd and bizarre illustrations borrowed from Slosson's interesting little book[1] are, of course, purely imaginary, yet they are singular thoughts that cause us to feel that we are sinking into bottomless space, into a shadowy realm of misty fantasy, where all our philosophy, our work and strife, our whole being, energy and desires, fade into ashen grey immeasurabilities.

## Space and a Fourth Dimension

According to the theory we are discussing, points that are far apart when measured in three dimensions, may be found close together in a fourth dimension. It will not be so difficult for us to grasp this idea if we assume time to be a fourth dimension, since events can apparently take place at the same instant although located thousands of miles apart. It is not, however, impossible

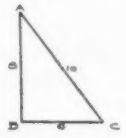


Fig. 1

to conceive of a fourth dimension as spatial instead of temporal when we attempt to grasp the problem with the use of an analogy.

Suppose, says Slosson,[2] that we lived in a "Flat-Land" of two dimensions only, with no thought of a third. Let us suppose that we would have such an instance in a worm crawling about on a sheet of paper. With its vermicular mind the worm would doubtless take a superficial view of the universe and would find it quite as impossible to imagine a third dimension as the average person finds it impossible to imagine a fourth.

If in the course of its peregrinations it came across a triangle drawn on the paper (see Fig. 1) it might so happen—were it a

[1] *Easy Lessons in Einstein*, pp. 40-56.
[2] *Easy Lessons in Einstein*, pp. 34-39.

measuring worm—that it would pace off the distance from A to B and find it to be 8 inches, likewise it might pace off the distance from B to C, finding it to be 6 inches. From this information, provided it had learned the law of the hypotenuse, it might calculate the distance from A to C as 10 inches. Measuring this distance it would find its calculations correct and thus it would gain perfect confidence in its plane geometry.

But let us now crumple up the piece of paper or roll it over so that points A and C are only one inch apart in the third dimension. Our poor worm, with its eyes fixed closely upon the paper, would know nothing of this event which had changed the distance between the points A and C in the third dimension, and the worm would still be correct in thinking the distance between these two points equalled 10 inches. We would also be correct when we asserted the distance to be one inch. The whole matter depends entirely on the point of view.

According to Einstein, something similar to this happens to our three dimensional space when ponderable matter gets into it.

When we divide the circumference of a circle by the diameter, the ratio figures out as 3.1415. . . . It has been calculated to 707 decimal places, but we shall dispense with the rest of them, calling the whole thing *Pi* for short. Einstein claims that when we place a heavy particle, let us say a lead bullet, at the centre of the circle, the ratio of the diameter to the circumference becomes slightly less than *Pi*, since the circle has, so to speak, been warped into a fourth dimension of space by a gravitational strain caused by the bullet. In such a case as has been described, the difference would be too small to be measured by any known means, but it is believed to be an actual, and not an imaginary deviation from our geometrical law.

Our solar orb, being a massive body, distinctly extends its gravitational field to a very considerable distance about it, and upon passing through this crumpled-up section of space, a ray of light, according to Einstein, would not be able to pursue a straight course. According to the eclipse observations, it does not.

Like everything else in nature, light follows the "easiest path." Just as a river pursues the easiest (*i.e.*, the gravitational) and not the shortest path to the sea, this natural tendency sometimes

leads it to meander over an entire continent. It appears that a light-ray pursues its way in almost exactly the same manner.

Most of us, I presume, imagine Newton's law of gravitation as a sort of invisible rope by which the sun drags the earth and other planets into their orbits when they are disposed to travel off on a tangent. But according to Einstein's theory we should rather suppose the planets to pick their way as best they can through a *space-and-time* combination that has been strained and distorted by the gravitational field of the sun.

Our solar system, as visualized by Einstein, may be compared with a spider web in which the sun occupies the centre like the spider while the planets, like flies, try to pass around and through the tangled strands. It is really much more complicated than this, for each planet possesses its own lesser web of radiating influence which it drags about with it like chains wherever it goes. Our attempts to explain the *modus operandi* of the movement of our solar system will doubtless be still further improved as new facts are disclosed; suffice it to say that our explanation is somewhat more reasonable than that of the ancient Babylonians and Hebrews who believed the sun and stars to be living beings, Gods or angels, moving of their own volition around the earth, or that each planet was guided in its orbit by its particular God or angel.

## Mutable Theories and Stable Facts

In bringing this already long paper to a close, may I be permitted to point out, for the benefit of any layman who may feel that certain of "*nature's laws*" have been repudiated and overturned by Einstein's theory, that the laws of nature, which the average person regards as abstract, immutable, universal, or eternal edicts, are to the working scientist no more than convenient formulas, mere mnemonic symbols for stringing together facts and thus making them easier to handle. The scientist knows full well that most of his theories are limited in their scope and only approximate in their accuracy, hence the delight the scientist takes in discovering these limitations and irregularities. He does not regard the so-called "*laws of nature*" with awe or reverence, indeed, he does not have any attachment for them at all—unless the "*law*" happens to be one he has formulated himself. He

invents an hypothesis whenever he needs one in his business, and for him the hypothesis is merely a new tool, a *novum organum*, to be discarded without hesitation when it has been proven that a better one has been discovered.

The scientist required an hypothesis to explain the transmission of light, magnetic force, etc., so he invented an ether. When he had created it he saw that it worked, and that is always the test of an hypothesis. Then Michelson and Morley discovered that certain properties the ether was supposed to possess were self-contradictory, since it refused either to move with the earth or to pass through it.

But these theoretical inconsistencies do not make the theory useless, Despite these inconsistencies, belief in the existence of an ether is a convenient way in which to account for certain natural phenomena, and the theory will continue in use until a better one is offered.

While Newton's hypothesis may involve certain inconsistencies, it would be quite erroneous to suppose that the foundations of modern science are being swept away by the recent discoveries. Einstein's theories are but an extension of the older theories. The "*laws*" enunciated by Newton still stand for all practical purposes, just as the "*laws*" of Euclid still stand for ordinary measurement.

While the new discoveries were unexpected and are revolutionary so far as our ideas of many things are concerned, no page of the millions recording the experience and observations of science is invalidated. No one's work is proven to be wrong. Revolutions in science do not destroy, they merely extend.

For the present this extension of the fundamental theories of the classical mechanics for which we are indebted to the genius of Newton is only a possibility. Astronomers and Physicists throughout the world look forward with deep interest to the results that are expected from the observations of the next eclipse of the sun, and it is hoped that these observations will prove or disprove at least one phase of the theory enunciated by the worthy successor of the immortal Leverrier, who similarly, with pen in hand, in the quiet of his study, established for us the material existence of a planet at that time quite unknown and unobserved.

## WIRELESS TIME SIGNALS OBSERVED AT OTTAWA

By R. Meldrum Stewart

THE arrangement and explanations are the same as for the previous list*, with the exception that the second and third columns give the observed corrections to the actual wireless signals from Annapolis, while the fourth and fifth contain the same quantity corrected for the announced errors of the Washington transmitting clock and for the adopted lag of Annapolis (.08 sec.).

The quantities in the eighth column have been reduced for clock rate to the uniform epoch 10 p.m. The observations are made with a six-inch meridian circle, with registering micrometer and reversing eyepiece; collimation and level are measured usually twice each evening; azimuth from star observations, smoothed by combination with meridian marks.

Dominion Observatory,
Ottawa, February, 1923.

*This Journal, Vol. XVII, p. 10 (Jan.-Feb., 1923).

| 1922 Date | Ottawa—Washington Observed Noon | Observed 10 p.m. | Corrected Noon | Corrected 10 p.m. | Lafayette (G. Sid. T.) 1st beat | 300th beat | ΔT at 10 p.m. Observed | Adopted |
|---|---|---|---|---|---|---|---|---|
| | s | s | s | s | h m s | h m s | s | s |
| Sept. 1 | −.07 | −.01 | −.09 | −.03 | 18 46 44.75 | 18 51 38.29 | +8.494 | +8.497 |
| 2 | −.09 | −.10 | −.08 | −.05 | | | | +8.475 |
| 3 | +.05 | +.06 | −.05 | −.03 | | | | +8.462 |
| 4 | +.03 | +.10 | −.04 | −.01 | 57 10.19 | 19 2 3.73 | | +8.453 |
| 5 | +.10 | +.07 | −.01 | −.03 | | | | +8.423 |
| 6 | +.03 | +.04 | −.04 | −.03 | | | +8.393 | +8.385 |
| 7 | +.03 | .00 | −.04 | −.06 | | | +8.359 | +8.336 |
| 8 | +.01 | −.03 | −.07 | −.10 | | | +8.259 | +8.272 |
| 9 | −.04 | +.02 | −.12 | −.06 | | | | −2.531 |
| 10 | −.01 | −.01 | −.09 | −.09 | | | −2.511 | −2.511 |
| 11 | +.04 | −.10 | −.06 | −.06 | | | | −2.466 |
| 12 | −.03 | −.05 | −.08 | −.08 | | | −2.442 | −2.441 |
| 13 | +.05 | −.02 | −.07 | −.12 | 19 32 19.09 | 37 12.61 | | −2.426 |
| 14 | −.03 | −.02 | −.13 | −.09 | 37 22.59 | 42 16.11 | −2.409 | −2.393 |
| 15 | +.02 | +.04 | −.07 | −.07 | 43 25.29 | 48 18.82 | −2.334 | −2.344 |
| 16 | .00 | .00 | −.09 | −.06 | 50 27.19 | 55 20.71 | | −2.304 |
| 17 | −.01 | +.02 | −.07 | −.04 | 49 37.68 | 54 31.21 | | −2.267 |
| 18 | +.01 | −.04 | −.05 | −.06 | 52 43.97 | 57 37.50 | −2.237 | −2.246 |
| 19 | −.02 | +.08 | −.02 | −.02 | 56 49.14 | 20 1 42.67 | | −2.232 |
| 20 | +.05 | +.04 | −.04 | −.03 | 20 0 54.17 | 5 47.70 | −2.216 | −2.222 |
| 21 | +.02 | +.05 | −.05 | .00 | 5 58.18 | 10 51.71 | −2.225 | −2.220 |
| 22 | +.05 | +.08 | −.05 | −.02 | 16 55.76 | 21 49.29 | −2.238 | −2.228 |
| 23 | +.03 | +.04 | −.04 | −.04 | | | −2.240 | −2.221 |
| 24 | +.06 | +.07 | −.02 | .00 | 18 14.81 | 23 8.34 | | −2.185 |
| 25 | +.10 | +.11 | +.01 | +.04 | 24 18.11 | 29 11.64 | −2.121 | −2.149 |
| 26 | +.08 | +.10 | −.01 | +.02 | 33 17.87 | 38 11.40 | | −2.133 |
| 27 | +.09 | +.07 | −.01 | −.02 | 31 12.16 | 36 5.69 | | −2.125 |
| 28 | +.03 | +.04 | −.05 | −.05 | 34 19.54 | 39 13.07 | | −2.137 |
| 29 | +.02 | +.01 | −.07 | −.08 | 37 26.53 | 42 20.06 | −2.137 | −2.119 |
| 30 | −.01 | +.01 | −.10 | −.08 | 41 32.34 | 46 25.88 | −2.090 | −2.078 |

| 1922 Date | | Ottawa—Washington Observed Noon | Observed 10 p.m. | Corrected Noon | Corrected 10 p.m. | Lafayette (G. Sid. T.) 1st beat | 300th beat | ΔT at 10 p.m. Observed | Adopted |
|---|---|---|---|---|---|---|---|---|---|
| | | s | s | s | s | h m s | h m s | s | s |
| Oct. | 1 | −.01 | −.04 | −.08 | −.07 | 20 50 32.64 | 20 55 26.17 | | −2.013 |
| | 2 | −.01 | −.03 | −.06 | −.07 | 51 41.53 | 56 35.06 | −1.956 | −1.940 |
| | 3 | .00 | −.01 | −.05 | −.05 | 52 50.50 | 57 44.04 | −1.839 | −1.847 |
| | 4 | +.05 | +.05 | −.04 | −.03 | 59 52.89 | 21 4 46.42 | | −1.770 |
| | 5 | +.06 | +.06 | −.04 | −.03 | 21 2 59.74 | 7 53.27 | | −1.683 |
| | 6 | +.05 | +.02 | −.05 | −.02 | 6 6.44 | 10 59.98 | | −1.592 |
| | 7 | +.02 | −.02 | −.02 | −.03 | 10 12.34 | 15 5.87 | | −1.499 |
| | 8 | −.01 | −.01 | −.03 | −.03 | 17 15.05 | 22 8.58 | | −1.411 |
| | 9 | −.06 | −.04 | −.03 | −.03 | 16 26.48 | 21 20.01 | | −1.328 |
| | 10 | −.05 | −.01 | −.03 | +.03 | 20 32.19 | 25 25.73 | | −1.231 |
| | 11 | −.02 | +.12 | +.03 | +.03 | 25 36.78 | 30 30.32 | −1.135 | −1.132 |
| | 12 | +.10 | +.09 | +.01 | +.01 | 32 39.26 | 37 32.79 | −1.015 | −1.037 |
| | 13 | +.10 | +.11 | +.02 | +.02 | 33 48.24 | 38 41.77 | −0.976 | −0.958 |
| | 14 | +.12 | +.12 | +.02 | +.02 | | | | −0.884 |
| | 15 | +.10 | +.12 | .00 | +.01 | 39 2.63 | 43 56.16 | | −0.795 |
| | 16 | +.09 | +.05 | −.02 | −.03 | 49 1.47 | 53 55.00 | | −0.712 |
| | 17 | +.05 | +.05 | −.02 | −.02 | | | | −0.597 |
| | 18 | +.03 | +.05 | −.02 | .00 | 51 18.98 | 56 12.51 | −0.511 | −0.511 |
| | 19 | +.04 | +.11 | −.01 | .00 | 55 24.52 | 22 0 18.04 | −0.433 | −0.428 |
| | 20 | +.10 | | −.03 | | 58 31.19 | 3 24.72 | −0.344 | −0.363 |
| | 21 | +.10 | +.15 | −.06 | −.04 | 22 3 35.68 | 8 29.21 | −0.311 | −0.303 |
| | 22 | +.17 | +.18 | −.05 | −.06 | 9 39.06 | 14 32.59 | | +6.823 |
| | 23 | +.03 | +.03 | −.06 | −.06 | 10 48.06 | 15 41.60 | | +7.019 |
| | 24 | +.01 | +.03 | −.11 | −.09 | 13 55.19 | 18 48.72 | | +7.218 |
| | 25 | +.03 | | −.09 | | 20 34.78 | 25 27.66 | | +7.420 |
| | 26 | +.01 | +.06 | −.09 | −.07 | 22 43.19 | 27 36.09 | | +7.651 |
| | 27 | +.03 | +.05 | −.05 | −.03 | 26 39.36 | 31 32.26 | +7.839 | +7.879 |
| | 28 | +.12 | +.11 | +.03 | +.01 | 29 47.64 | 34 40.56 | +8.183 | +8.137 |
| | 29 | +.10 | +.10 | +.01 | +.01 | 35 45.74 | 40 38.66 | | +8.363 |
| | 30 | +.08 | +.14 | .00 | +.03 | 39 45.91 | 44 38.83 | | +8.570 |
| | 31 | +.09 | +.12 | .00 | −.01 | 41 48.66 | 46 41.57 | +8.768 | +8.762 |

# THE LIFE AND WORK OF TYCHO BRAHÉ

By R. A. Gray

TYCHO BRAHÉ, the son of a Danish nobleman, was born in the year 1546, shortly after the period of the New Learning and of the Reformation. He lived between the times of Copernicus and of Kepler, and he passed away in 1601, just before Galileo announced in 1609 his discovery of the telescope.

Before giving a brief sketch of his life, it will be useful to recall the theories of the earth and the stars that prevailed for many centuries among all nations. To-day if a child were to be asked which he considered stationary, the earth, or the sun, moon, and stars, he would without hesitation reply that the earth was firm and unmovable and that the sun, moon, and stars travelled across the sky. The sun, he knows, rises in the morning, passes to the meridian and sinks at evening in the west. Our senses to-day tell the same thing to us that they do to the children, and that they did to the ancients. The ancients accepted the evidence of their senses as the true explanation of the visible world. The advance in our knowledge since these early times is the result of pure intellect founded on accurate observation.

Ptolemy of Alexandria, an Egyptian of about 130 A.D., wrote a treatise on astronomy in which he propounded his theory of the universe, a theory that held sway for fourteen hundred years and on which no advance was made until the time of Copernicus, a German mathematician, who died three years before Tycho Brahé was born. Ptolemy inferred that the earth was not flat, for if it were the sun would set at the same instant for all people, no matter at what place they lived on the earth. In these days of the electric cable, the telegraph and the radio, we can learn the position of the sun in the heavens at any part of the world almost at the same instant that the question is asked. Ptolemy, having no telegraphs, used a lunar eclipse to confirm his views. When the earth intercepts the rays of the sun that fall towards the moon, the shadow of the earth should be seen at nearly the same instant,

no matter where the observer is situated on the earth. Ptolemy found that at places east of Alexandria the local time of the eclipse was later than at Alexandria, while at places to the west the local time was earlier, and, consequently, the earth could not be flat. He was confirmed in this opinion by observing the hulls of ships on the Mediterranean disappearing before the sails.

The earth must be a huge sphere resting in space with the sun, moon and stars revolving about it. As the stars did not change their positions relatively to each other he concluded that they were bright points on the inner surface of a huge rotating globe. He learned, too, by observation that the sun, moon, and the planets were not so far distant as the stars and hence there must be several transparent spheres bearing these heavenly bodies. From this theory arose the notion that the revolution of these spheres produced heavenly music inaudible to human ears, and heard by Divine beings only.

Dante placed heaven in these several spheres; the spirits of the moon inhabited the first of these spheres, Mercury was the second heaven, Venus the third, the Sun the fourth, Mars the fifth, Jupiter the sixth, Saturn the seventh, and the stars the eighth.

Ptolemy was a very clear thinker and he knew that when he travelled by boat on the Nile objects on the bank appeared to move, while in reality it was the observer that moved and not the objects. The apparent motion of the sun and stars could also be explained if the earth moved and the stars were stationary, yet he rejected the theory that the earth rotated, and accepted that of a fixed earth and movable stars because of his inability to grasp the idea that the air and all objects on or near the earth would be carried with the moving earth just as a running person carries his clothing. The ancients had the idea that if, for example, a bird flew from a branch the speed of the revolving world would leave the bird far behind, or if a stone were dropped from a high tower the tower would move away from the stone as it fell. As these phenomena did not occur the inference was that the earth could not rotate.

But Ptolemy went a step further. It was a matter of common observation that the planets did not travel uniformly, but that at certain seasons they had a retrograde movement among the stars.

An excellent opportunity was afforded during the past summer of observing the retrograde movements of several of the planets. The sun travels almost uniformly among the stars, while Venus, for example, is seen sometimes on one side of the sun and sometimes on the other, and, in fact, all planets have these retrograde movements.

Ptolemy devised a theory to account for these erratic movements. The planets, he thought, travelled in circular paths, for the circle was the only perfect curve, and creation, being perfect, must have circular motion. To account for the retrogression, a planet was supposed to move in a circular path, the centre of which moved in a circle about the earth. In the diagrams the distances of the planets and of the sun are not drawn to scale.

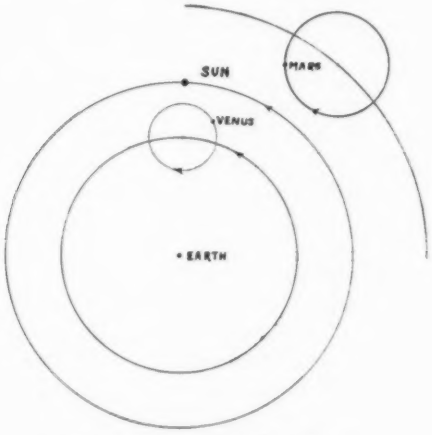



Fig. 1—Ptolemy's Theory of the Planets

This theory was called the geocentric theory of the universe, and the planets moved in epicycles. Calculations of the positions of the planets by this theory were approximately correct, and the theory held sway, as has been stated, for fourteen hundred years. The church and all learned men believed it. Copernicus, who was born in 1476 at Thorn on the Vistula and who died in 1543, held the view that the earth revolved and that the fixed stars were not

on a huge, swiftly revolving transparent sphere. He published a book explaining his theory, but fearing persecution he took the precaution to die before it was published.

Three years after the death of Copernicus Tycho Brahé entered the world. He was the eldest son of a prominent Danish nobleman and was promised just after his parents were married to a bachelor uncle, George Brahé. But when the first-born son arrived the parents' love for their offspring caused them to break their promise to the uncle. When, however, a second son appeared Uncle George immediately kidnapped Tycho and brought him up, his parents ultimately acquiescing.

In 1559 the young Tycho, thirteen years of age, entered Copenhagen University. The subjects chosen for him were Rhetoric and Philosophy, but he preferred Mathematics and Astronomy. In 1560 an eclipse of the sun impressed Tycho so much because of the fact that it had been predicted by astronomers that he spent all his spare time studying the stars. For three years he remained at Copenhagen, after which his uncle sent him to Leipsic to study along with a tutor—who later became an eminent historiographer—with the hope that the tutor would influence him to study subjects then considered worth while and drop astronomy. But Tycho evaded his tutor and spent his time very profitably in his chosen subject. He obtained two sets of astronomical tables, the Alphonsine and the Prutenic, and soon discovered that his own observations differed from both these sets. The Alphonsine tables, published in 1483, were prepared by Jewish and Arabian astronomers and were based on the theories of Ptolemy; the Prutenic (Prussian) were issued in 1551. So when Tycho was but seventeen years of age he saw that more accurate observation was the key to the future advance of astronomy.

He remained at Leipsic until 1565, when he was recalled to Denmark because war had broken out with Sweden. Shortly after his arrival in Denmark his Uncle George died, the probable cause being pneumonia contracted by plunging into the icy waters to save King Frederick II when he accidentally rode off a bridge in Copenhagen. There being none left to object to Tycho's study of astronomy he returned, after the war, to Germany, where he spent six years at the Universities of Wittenberg, Rostock, and

Augsberg. At Rostock, in 1566, when Tycho was twenty years of age, he was a guest along with another Danish nobleman at the home of one of the professors. The two Danes quarrelled over a pretty girl who was present, and a few days later, at seven o'clock one evening, when it was quite dark, they settled the dispute with swords. Tycho there lost part of his nose but he replaced it with an artificial one of gold and silver.

In 1571 his father died and left his estate to Tycho and his other son.

A new star appeared in Cassiopoeia in November, 1572, and was observed first by Tycho Brahé, who, for the eighteen months of its appearance, devoted considerable attention to it. He tried to find its distance from the earth, but as no parallax could be found for it, he came to the conclusion that the Nova was situated on the outer sphere of the heavens. This conclusion was contrary to the generally accepted ideas that the universe was perfect and nothing new could be discovered therein. The only new stars previously observed were one mentioned by Hipparchus about 150 B.C., and the star of Bethlehem. Comets appeared now and then, but they had tails and were supposed to be atmospheric phenomena.

Tycho published a book on the new star which brought him very prominently before the learned world. In order to receive the recognition that his labours merited he determined to return to Germany, but King Frederick II thought that Denmark could not afford to lose the prestige of his celebrated subject, and Tycho was invited to remain in his native land, and promises of substantial aid were made to him. In addition to annual money grants, which were increased as his observatories expanded, he received the Island of Hween, situated to the north of Denmark, an island of some 2,000 acres, now belonging to Sweden.

In 1573 he married. Little is known of his wife. She was not in the same station in life as her husband; some say she was a servant in the house, others a farmer's daughter on his estate, others the daughter of a clergyman. As his taste did not lie in society but wholly in astronomy, she made him a very suitable wife and allowed him uninterrupted opportunities to pursue his favourite studies. He had eight children and the mother had plenty

to do without going into society. Tycho Brahé remained on the island of Hween for twenty years building observatories, constructing all kinds of astronomical instruments, the like of which the world had not previously seen, and attracting to himself a number of able young mathematicians and astronomers. With the utmost care and accuracy he recorded all the observations that were made in his observatories, and by so doing in reality laid the foundations of the modern science of astronomy.

Many famous and learned men visited Tycho Brahé, among whom might be mentioned James VI of Scotland and I of England, who spent eight days of his wedding trip at Hween, becoming acquainted with many of the wonderful discoveries made by Tycho. The Duke of Brunswick, brother-in-law both of the Danish King and of King James, also paid a visit at the same time, and taking a fancy to a little revolving Mercury which stood on the roof of the central dome of one of the observatories, he took it away with him to Germany, and like some of his descendants and fellow countrymen of recent years never returned it, though Tycho Brahé frequently brought the matter to his attention.

King Frederick II of Denmark was very generous in his treatment of the astronomer. Many sources of revenue were placed at his disposal by the king. One of these was the rent received by a lighthouse. Tycho was granted this income on condition that he would keep the light burning, but mariners complained of its neglect, for Tycho was more interested in star light than in lamp light. He also received the canonry of a cathedral, which he also neglected. Later in life he treated his tenants very arbitrarily, and on the whole so many complaints were made to the new King and his advisors, and so many bills were sent in to meet deficits from the observatories, that support was withdrawn and Tycho's revenues were practically extinguished. He decided to leave Denmark and settle in Germany. The Emperor, a noted patron of learning, gave him the choice of three castles in which to pursue his studies and he chose Benatky, on the Iser near Prague, but Tycho Brahé asked so much money for his observatories, and there was so much delay in getting support for his plans, that he left for Prague.

While at Benatky, Tycho was assisted by Kepler, who became his pupil and who made use of Tycho Brahé's accurate observations for formulating and testing the famous laws enunciated by him.

Tycho Brahé did not long survive the bitter disappointments of his later years, and in 1601 he died at the age of fifty-five.

To some extent, especially in earlier life, Tycho Brahé accepted the teachings of astrology prevalent in his day. His book on the new star in Cassiopoeia which he wrote when he was twenty-three years of age contained ideas such as are found in the following excerpt from it: "The star was at first like Venus and Jupiter, and its effects will therefore first be pleasant, but as it became like Mars there will next come a period of wars, seditions, captivity, and death of princes, and destruction of cities, together with dryness and fiery meteors in the air, pestilence and venomous snakes. Lastly the star became like Saturn and there will therefore finally come a time of want, death and imprisonment, and all kinds of sad things."

*(To be concluded)*

## REVIEW OF PUBLICATIONS

*L'Annuaire du Bureau des Longitudes* pour 1923. 726 pages, 3¾×5¾ in., with 5 star maps in colours, one magnetic map and a supplement of 15 plates showing the distribution of rain in France. Paris: Gauthier-Villars, price 6.50 francs.

This annual began publication in 1796 and it has continued ever since without interruption. It contains much information on astronomy, weights and measures, geography, tonnage of ships, and other subjects. In addition there is an article of 114 pages on the Climate of France by G. Bigourdan, and biographical notices on Gabriel Lippmann and Jules Carpentier by P. Appell and A. Jobin, respectively. Lippmann was born in 1845, and during his life rose to the first rank among French scientists. His biographer says: "France loses in Lippmann a great scientist, a man of the race of Ampère, Claude Bernard, Pasteur, Hermite, Poincaré, who are not only the glory of a country but the pride of humanity". Carpentier was born in 1851 and died on June 30, 1921, from an automobile accident. He was a great engineer and became well known as the constructor of electrical instruments of the highest class.

This little encyclopedia, convenient in form and cheap in price, should find a place in every library.

C. A. CHANT.

*The Parallaxes of Fifty Stars determined at the Sproul Observatory* (Third List), by John A. Miller and John H. Pitman, with the collaboration of Caroline H. Smedley and Margaret E. Powell. Publication No. 6 of the Sproul Observatory, Swarthmore, Pa.

Ever since the 24-inch refractor was installed at the Sproul Observatory Professor Miller has been engaged on a parallax programme, and this contribution brings the number of stars up to 150. The number of plates used for each star varies from 11

to 17. Omitting the value of 0″.555 obtained for Barnard's proper motion star, the greatest parallax is 0″.090. Wherever available other measurements of the parallax of each star are given for the sake of comparison, and it is interesting to note the general agreement between the values secured by the spectroscope and by photography.

C. A. C.

*Annual Report of the Director of the U.S. Coast and Geodetic Survey* for the year ended June 30, 1922. Washington: Government Printing Office.

This is the 91st annual report though the Coast and Geodetic Survey has been in existence over 100 years. It gives a concise statement of the operations of the Survey in its different fields of work which extend from Alaska to the Virgin Is. and across the Pacific to the Philippine Is. With a comparatively small appropriation an extensive programme has been carried out and this volume gives an interesting account of what has been accomplished during the year. It is illustrated with 38 charts. The Director explains in detail the needs of his office, the greatest being an immediate increase in the salaries of the staff in order to secure and retain men of ability.

C. A. C.

*The Making of Topographical Maps of Cities and Towns, the first step in Town Planning*, by Douglas H. Nelles. Publication No. 9 of the Geodetic Survey of Canada.

This 40-page pamphlet on city mapping shows how useful the Geodetic Survey can be to a city. Our organization is very complex and our problems of sanitation and of public works generally depend to a large extent on an accurate survey of the land within the city's limits, and that must be connected to a survey of the surrounding country. An outline of the method of triangulation, of running a system of levels and of the production of maps suitable for city and country is given. Samples of maps of the city of London, Ont., and of the Dominion Observatory grounds, Ottawa, are given.

C. A. C.

## NOTES AND QUERIES

**Communications are Invited, Especially from Amateurs. The Editor will try to Secure Answers to Queries**

### Visit to Ottawa and Montreal

During the last week of January the present writer had the privilege of addressing the Ottawa and Montreal Centres, and was pleased to see the active interest in the society shown at these places. The meetings at Ottawa are held in the auditorium of the Victoria Museum and are very well attended. A special course of five lectures given at intervals of two weeks is in progress and is proving very successful. There is a rich mine of talent in Ottawa to draw from.

At Montreal the meeting was held in the Physics Building of McGill University and the writer was pleased to lecture in this great seat of learning before a large and distinguished audience. In the evening, before the lecture, the writer was honoured by invitation to a dinner at the University Club, at which there was a galaxy of intellect, though it was declared by Sir Arthur Currie to be rather a "gastronomic" galaxy. The writer will be excused if he feels satisfaction in giving the names of those present, as follows:—Mr. Justice E. E. Howard (President of the Montreal Centre), Sir Arthur Currie (President of McGill University), Dr. F. D. Adams (Dean of Applied Science), Dr. Gordon Laing (Dean of Arts), Mr. Julian Smith, Mr. W. Stewart, Mr. Sharp, Mr. A. W. Strong, Dr. J. B. Porter, Dr. A. S. Eve, Dr. A. N. Shaw, Dr. L. V. King, Mr. H. E. S. Asbury, Dr. D. A. Murray, Prof. H. E. Reilley, Dr. D. A. Keys, Prof. A. H. S. Gillson, Dr. R. F. Ruttan, Prof. R. Du Roure, Dr. H. T. Barnes.

### A Change in an Orion Star?

Under date January 30, 1923, Mr. Fred S. Carrington, of Washta, Iowa, writes as follows:—

Since Sunday the 21st I have several times observed in the region of the Orion nebula, a little above the 'trapezium' towards

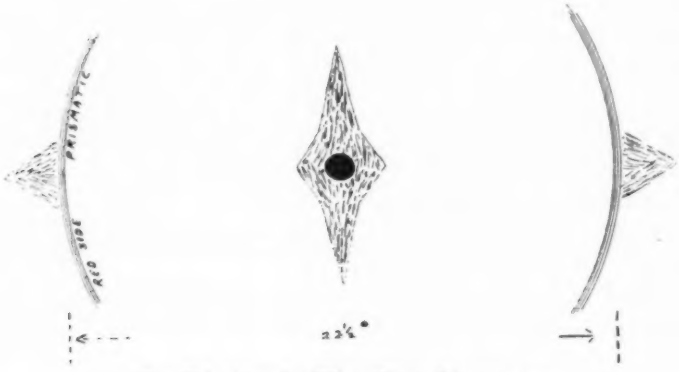
the west three conspicuous stars in a straight row. Mr. Serviss speaks of these stars as "like a row of buttons on a coat and showing an extraordinary liveliness of radiance." The farthest star to the north-west has now 'winked down' in brightness so that it is very little more than half as bright as the other two. Has this been noticed by any of your observers? This star is nowhere listed as variable and if variable must have a long period.

### An Interesting Halo Seen in Alberta

Our valued correspondent Mr. H. B. Collier sends a note on a halo seen at Viking, Alberta, on February 3, 1923, as follows:—

I enclose herewith a sketch of a moon halo which appeared here on the 3rd, and if ever a pen failed to do justice, this pen is guilty, I assure you. While I have been fortunate in seeing several remarkable sun halos, this attempt of the moon to rival the sun appears all the more extraordinary.

The prismatic bows appearing at the usual location of parhelia or false-suns were very clear and distinct, the red side of the prism being toward the moon. About the moon and back of each bow a well-defined blaze of light completed a lunar display of borrowed light which was glorious to behold.




Moon Halo observed at Viking, Alberta, February 1, 1923

### The State of the Society

A perusal of the minutes of the Annual Meeting of the Society, printed in this issue, will show that the Society is in a flourishing condition, and that the different Centres are enthusiastically carrying on their work. The number of members was never so large and the continual increase is very gratifying. But there is much room for improvement still. Many more would join the Society if its objects and methods were drawn to their attention. Let us make a great advance in 1923. From every quarter of the globe requests come for our publications, and the editor would like to make them still more worthy of a wide distribution. But the cost of printing and of engraving is very great and more members and more funds are required to make further extensions.

### A Remarkable Stellar Outburst

The announcement was telegraphed from Athens that the star Beta Ceti, usually of magnitude 2.2, had suddenly blazed out brighter than many first magnitude stars. The observation was said to have been confirmed by Flammarion at Juvisy and later at Yerkes observatory. It seems, however, that the star was confused with Mira, which is now at the maximum though its magnitude is only 2.5. Mira is to be seen in the south-western sky just after sunset, and it can be identified from the map on the third page of the cover of the Handbook for this year.

C. A. C.

# MEETINGS OF THE SOCIETY

## AT WINNIPEG

Dec. 13, 1922.—The meeting was held in the usual place, Room 21, University Arts Building, the President, Mr. Allan, occupying the chair.

The President opened the discussion of the purchase of a telescope, and suggested the opening of a subscription list. Mr. Bastin moved that the subject of the telescope be left to a subsequent meeting, partly on account of the small number of members present, and partly to give time to secure more definite information bearing on the matter, particularly regarding assistance from the parent society. This motion was seconded by Mr. Shirley Brooks, and carried.

It was moved by Mr. Roy, seconded by Mr. Ward, that a list be opened for voluntary subscriptions for the purchase of a telescope. The motion was carried, and Mr. Roy headed the list with a subscription of ten dollars.

The financial report for the year was read by Mr. Allan, who, with Mr. Bastin, had audited the books of the treasurer. Mr. Powell moved the acceptance of the financial report; Mr. Roy seconded the motion, and it was carried.

The annual report of the secretary was read, acceptance was moved by Mr. Bastin, seconded by Prof. MacLean, and the motion carried.

The meeting elected the officers for 1923. (Their names appear elsewhere in this issue.)

Rev. Euclid Gervais, S.J., of St. Boniface College, was elected a member.

On the suggestion of the treasurer, it was moved by Mr. Bastin, seconded by Mr. Brooks, that a present of five dollars be made by the Society to the night watchman, and that the thanks of the Society be tendered him for his helpfulness. The motion was carried.

Mr. Allan gave an entertaining talk on the planets, Jupiter and Saturn, after which the meeting adjourned.

C. D. MILLER, *Secretary.*

## AT MONTREAL

Jan. 26.—The meeting was held in the Physics Building of McGill University. The President, Mr. Justice E. E. Howard, occupied the chair. A large and distinguished audience was present, among whom were Sir Arthur Currie, Principal of McGill University, and Deans Adams and Laing.

The following have been elected members of the Society:

Mr. E. E. Budgen, 86 Decarie Boulevard, Notre Dame de Grace, Montreal.

Mr. Howard Murray, 51 Belvedere Road, Westmount.

Mr. J. C. Smith, 314 Lansdowne Ave., Westmount.

Mr. J. L. Weir, 70 Rosemount Ave., Westmount.

A letter from the former Secretary-Treasurer, Rev. W. T. B. Crombie, was read stating his regrets that an indisposition prevented him from having the pleasure of meeting Prof. Chant.

The Secretary was requested to send on behalf of the Society a letter to Mr. F. R. Roberts expressing deep sympathy at the death of his son.

Mr. Justice Howard then introduced Prof. C. A. Chant of the University of Toronto to address the Society on "The Eclipse Expedition to Australia". Prof. Chant in his opening remarks expressed his pleasure at speaking to representatives of McGill, mentioning the high esteem in which she is held by Toronto. The Eclipse Expedition reminded him of the 1905 Labrador Expedition on which he met our Hon. Pres., Mgr. C. P. Choquette, and other men from Montreal.

The object of the recent expedition was to obtain evidence in regard to the Einstein Theory, which Prof. Chant stated he takes seriously; for, if we obtain evidence in favour of the Theory, there shall have to be a modification of the ideas and concepts at the basis of our physical science.

The lecturer explained how the stars about the sun were photographed during the eclipse to test Einstein's prediction that the rays of light are bent in passing the sun. He also referred to the generous treatment by the Australian Government and to the helpfulness of the Lick party in taking the night-plates at Tahiti, required for comparison with the eclipse plates.

Prof. Chant by a series of superb slides took the audience through the numerous places the party visited, giving touches here and there of the native life and scenery. Honolulu and Fiji were passed in turn on the way to Sydney; thence on to Melbourne where all admired the luxuriant vegetation of the Botanical Gardens. While at Perth, the capital of Western Australia, a State luncheon was tendered the Astronomers at the Parliament House. Here, also, the party boarded the *Charon*, a 2,800 ton steamer for Broome, some 1,500 miles away on the N. W. coast; at this place they changed to a 80 ton wooden schooner which carried them back along the 90 Mile Beach to the landing place for Wallal. All the instruments were unloaded in due time and transported by large donkey teams through the heavy sand to the chosen station about one and one-half miles inland. The camp consisted of twelve good-sized sleeping tents together with those for storing and eating.

Difficulties experienced in photographic work at the camp were described, resulting in the decision to develop the critical plates at Broome. The manner in which the exposed plates were protected until they were finally developed was explained, and reference was made to the relief felt when it was learned that the plates were good.

Dr. Eve, in voicing the thanks of the Society to Prof. Chant, made mention of the great name that in the last few years Canada has achieved for herself in Astronomy partly through the Victoria Telescope and partly through Prof. Chant's teaching at Toronto.

L. SESSENWEIN, JR., *Recorder.*

## AT VICTORIA

January 16.—The regular meeting of the Society was held in the Girls' Central School. The President, Mr. W. E. Harper, in the chair.

The following members were duly elected: Mr. J. R. Cowell, Dr. D. W. Graham, Master Victor Montaldi, Mrs. Geo. Riley, Dr. Gordon Kenning, Mr. W. T. Bridge, Dr. W. J. Sipprell.

The President then called upon Mr. J. Duff to give an address on "Meteors and Meteorites". In primitive times meteorites were worshipped as fetishes as instanced by "the image that fell from Jupiter". The vivid description of a fire ball in the second book of the Aeneid was quoted. The only theory regarding the phenomena in early times was that they were exhalations akin to the *ignis fatuus*. About 1800 the first scientific data were obtained. Parallax observations gave their height from 60 to 100 miles with a velocity of 10 to 40 miles per second. The Radiant point was explained and by means of a model the lecturer very clearly illustrated the position of orbits and the probable existence of enormous numbers that never meet the earth.

The Leonid swarm of 1799, 1833, 1866-7 had its orbit determined by Newton of Yale, and traced back to 126 A.D., when these meteors became "naturalized" citizens of the solar system through the influence of Uranus. Their velocity readily accounted for the heat and light produced.

Slides were shown of Peary's 39½ ton Aghnito and others. Theories as to their birthplace or grave were also illustrated by slides.

Mr. W. H. Christie then spoke on "Practical Astronomy for Amateurs". The object of the address was to show with what simple equipment the amateur can make valuable observations on meteorites and variable stars. Working under suitable conditions the observer draws a line on the star-map representing each meteor seen, noting its magnitude, colour and duration. For observing variable stars even a pair of binoculars is sufficient. .

The five classes of the late E. C. Pickering were described and the light curve of each type was shown.

The method of determining the magnitude of the variable was described and the lecturer offered the use of maps of the region of naked eye variables to members of the Society.

A short discussion followed on the possibility of recent volcanoes being able to send out meteors—and the President commented on the desirability of the Society having a 3″ telescope. A vote of thanks was passed and the meeting adjourned.

F. Moore, *Secretary.*

# The Royal Astronomical Society of Canada

## OFFICERS FOR 1922 (Revised to March 1st, 1922).

*Honorary President*—Hon. R. H. Grant, Minister of Education for Ontario.
*President*—W. E. W. Jackson, M.A. *First Vice-President*—Wm. Bruce, J.P.
*Second Vice-President*—R. M. Stewart, M.A.
*General Secretary*—A. F. Hunter, M.A. *General Treasurer*—H. W. Barker.
*Recorder*—J. H. Horning, M.A. *Librarian*—Prof. C. A. Chant, M.A., Ph.D.
*Curator*—R. S. Duncan.

*Council*—Sir Joseph Pope, K.C.M.G.; Otto Klotz, LL.D., F.R.A.S.; Stuart Strathy; Prof. L. Gilchrist, M.A., Ph.D.; W. M. Wunder, M.D.; A. R. Hassard, B.C.L.; R. A. Gray, B.A.; Mgr. C. P. Choquette, M.A., Lic.Scs.; J. A. Pearce, M.A.; Prof. John Matheson, M.A. and Past Presidents: John A. Paterson, K.C., M.A.; Sir Frederic Stupart, F.R.S.C.; Prof. A. T. DeLury, M.A.; Prof. Louis B. Stewart, D.T.S.; Albert D. Watson, M.D.; Allan F. Miller; J. S. Plaskett, B.A., D.Sc.; J. R. Collins; and the Presiding Officer of each Centre as follows: R. E. DeLury, Ph.D., Ottawa; H. E. S. Asbury, Montreal; H. B. Allan, Winnipeg; W. E. Harper, M.A., Victoria; and Prof. H. R. Kingston, M.A., Ph.D., London.

### OTTAWA CENTRE

*President*—R.E. DeLury, Ph.D. *Vice-President*—G. H. Herriot, B.A.Sc.
*Secretary*—R. J. McDiarmid, Ph.D. *Treasurer*—D. B. Nugent, M.A.

*Council*—T. L. Tanton, Ph.D.; A. M. Narroway, D.L.S.; C. A. French, B.A.; and Past Presidents: Otto Klotz, LL.D., F.R.A.S.; C. A. Biggar, D.L.S.; F. A. McDiarmid, M.A.; R. M. Stewart, M.A.; J. J. McArthur, D.L.S.

### MONTREAL CENTRE

*President*—H. E. S. Asbury. *First Vice-President*—E. E. Howard, K.C.
*Second Vice-President*—A. S. Eve, M.A., C.B.E., D.Sc., F.R.S.
*Secretary-Treasurer*—Rev. W. T. B. Crombie, M.A., B.D.
*Recorder*—H. E. Markham.

*Council*—Mgr. C. P. Choquette, M.A., Lic.Scs.; Miss M. Ellicott; John Corway; Prof. L. V. King, M.A., D.Sc., F.R.S.C.; F. R. Robert; Geo. Sample; James Wier, B.Sc.

### WINNIPEG CENTRE

*President*—H. B. Allan. *Vice-President*—Mrs. E. L. Taylor.
*Secretary-Treasurer*—Prof. C. D. Miller, Ph.D.

*Council*—Prof. L. A. H. Warren, Ph.D., F.R.A.S.; C. E. Bastin, B.A.; J. H. Kolb, T. H. Johnston, A. W. Meggett.

### VICTORIA CENTRE

*President*—W. E. Harper, M.A. *Vice-President*—F. C. Green.
*Secretary*—R. K. Young, D.Sc. *Treasurer*—J. P. Hibben.

*Council*—Mrs. W. B. Christopher; F. Moore; A. Symonds; K. M. Chadwick; J. Duff; John Dean; and Past Presidents: F. Napier Dennison; A. W. McCurdy; W. S. Drewry; and J. E. Umbach.

### LONDON CENTRE

*President*—Prof. H. R. Kingston, M.A., Ph.D.
*Vice-President*—Miss Grace Blackburn. *Secretary-Treasurer*—E. T. White.

*Council*—Rev. R. J. Bowen; H. B. Hunter; Mrs. S. R. Moore; J. C. Middleton; and W. A. McKenzie.

## FOR SALE

THE FESTIVAL OF THE DEAD, by R. G. HALIBURTON.

This very scarce pamphlet, printed privately in 1863, was republished in the JOURNAL of the R.A.S.C. and can be obtained in a book of 126 pages. The work discusses the Year of the Pleiades and various questions relating to old calendars. It is of special interest to astronomers, anthropologists and ethnologists. Price $1.00, post-paid.

## WANTED

BULLETIN DE LA SOCIÉTÉ ASTRONOMIQUE DE FRANCE. Volume 5, for year 1891.

Apply to C. A. CHANT,
*Librarian*, R.A.S.C.